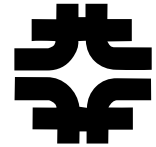


Overview of the Laboratory

Michael Witherell

Tevatron Operations Review

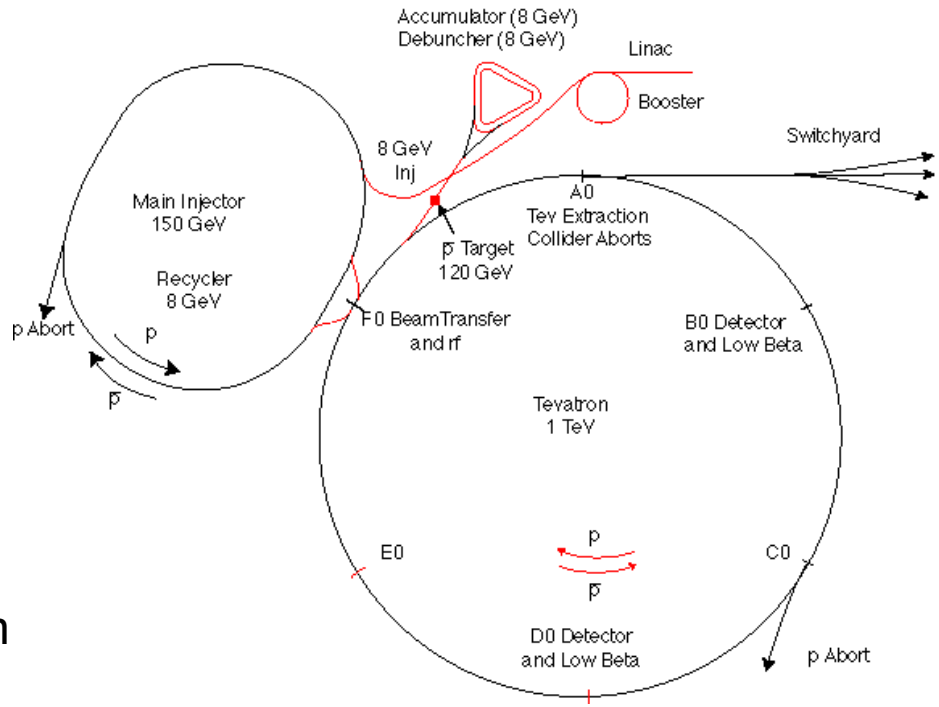
March 29, 2005

About Fermilab

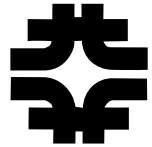
- Fermilab's Tevatron is the world's highest-energy particle accelerator and collider.
  - CDF and D0 experiments
- Fermilab operates the only accelerator-based neutrino program now operating.
  - MiniBooNE
  - MINOS
- Fermilab is also host to
  - the U.S. program for the LHC accelerator and CMS experiment; and
  - a strong program in particle astrophysics.

The Accelerator Complex

- Fermilab has the largest and most complex system of accelerators operating at any laboratory.
  - 8 GeV Proton source with Booster neutrino beam
  - Antiproton source
    - 8 GeV Debuncher
    - 8 GeV Accumulator
  - 8 GeV Recycler
  - 150 GeV Main Injector with NUMI neutrino beam and SY 120 beams
  - 980 GeV Tevatron with collider experiments

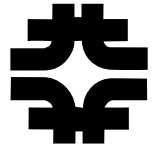


The Accelerator Complex



- Accelerator operations are more intricate than ever.
- MCR e-log, 3/18/05:
  - “Pbar Stacking.
  - Beam to NuMI.
  - Beam to MiniBooNE.
  - Beam to Switchyard.
  - Store #4046 colliding.”

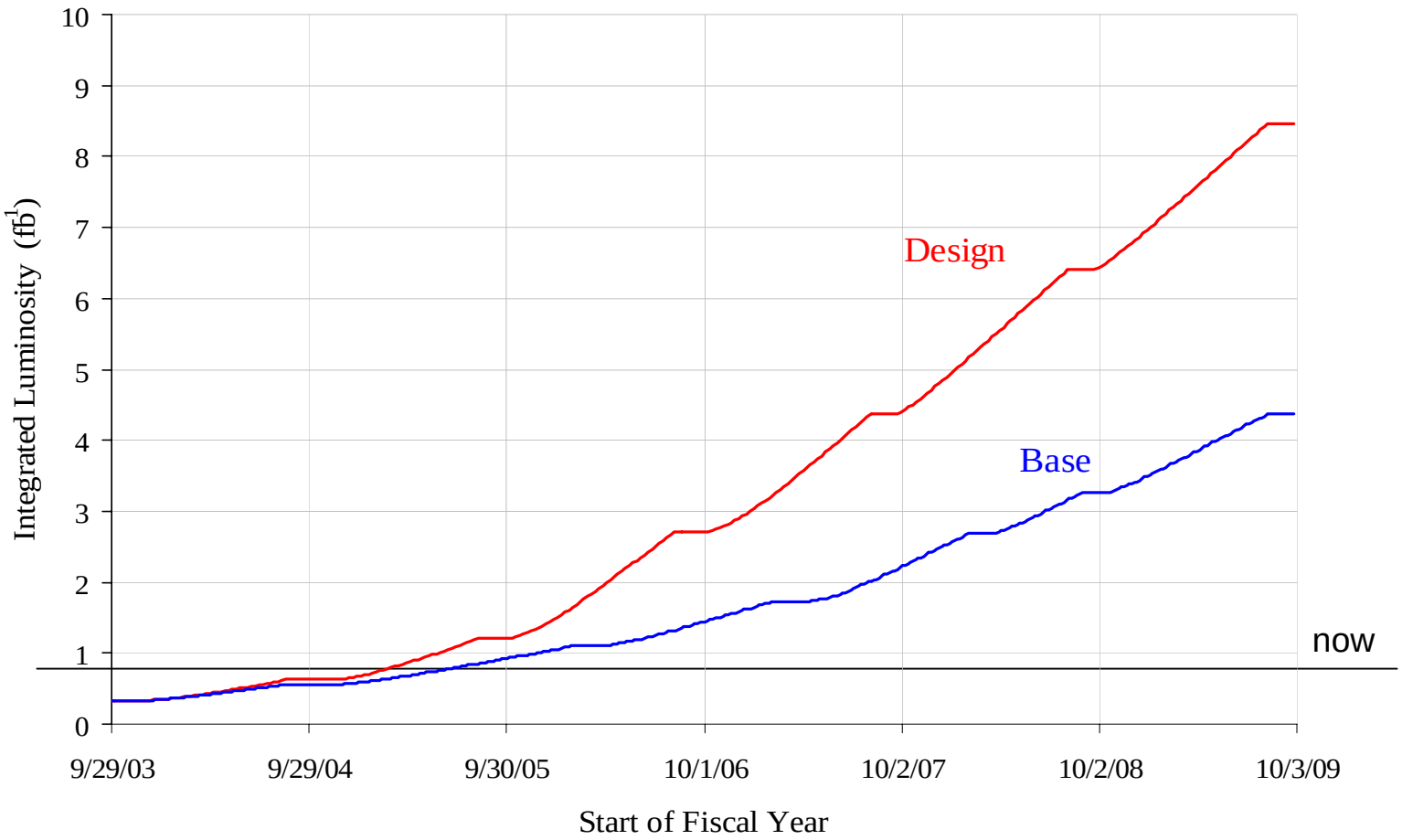
Run II



- Several of the most important areas in particle physics are being addressed only by CDF and DZero right now:
  - Electroweak physics: top and W mass, diboson production
  - Supersymmetry searches
  - B physics: Δm_s & $\Delta\Gamma_s$, B_c, B_s decays
  - Extra dimensions
  - Quark compositeness, high p_T jets
- Published, accepted, and submitted articles on Run II physics:

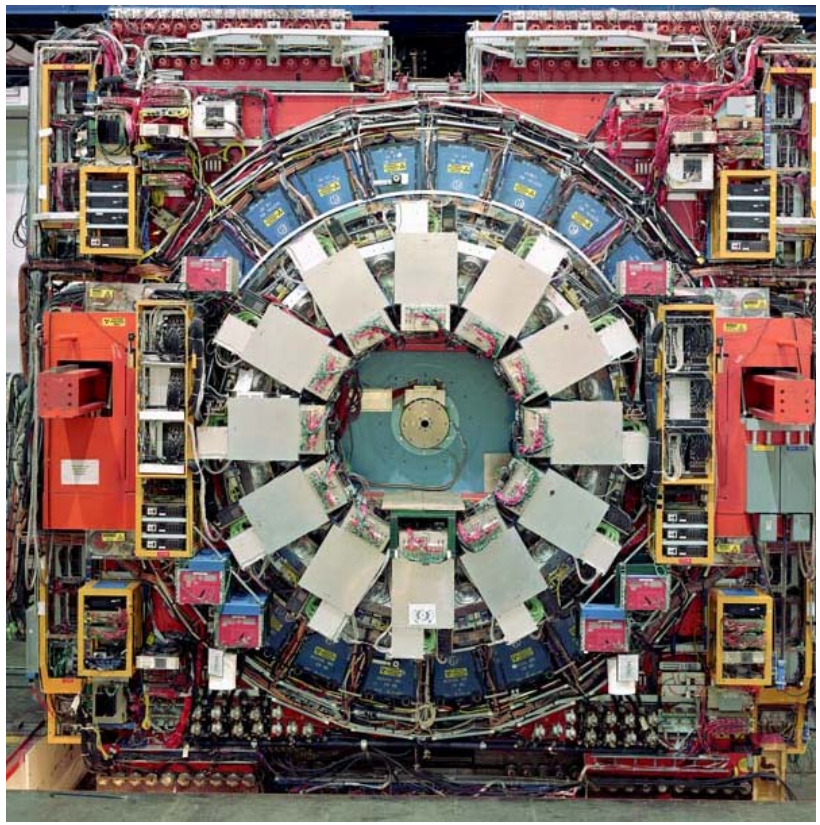
Run II Record	PRL		PRD	
	Pub. & Acc.	Sub.	Pub. & Acc.	Sub.
CDF & D0	19	13	7	3

Projected Integrated Luminosity

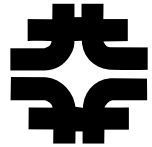


CDF and D0 at the Tevatron

Two detector facilities, each producing data for a 600-scientist collaboration.

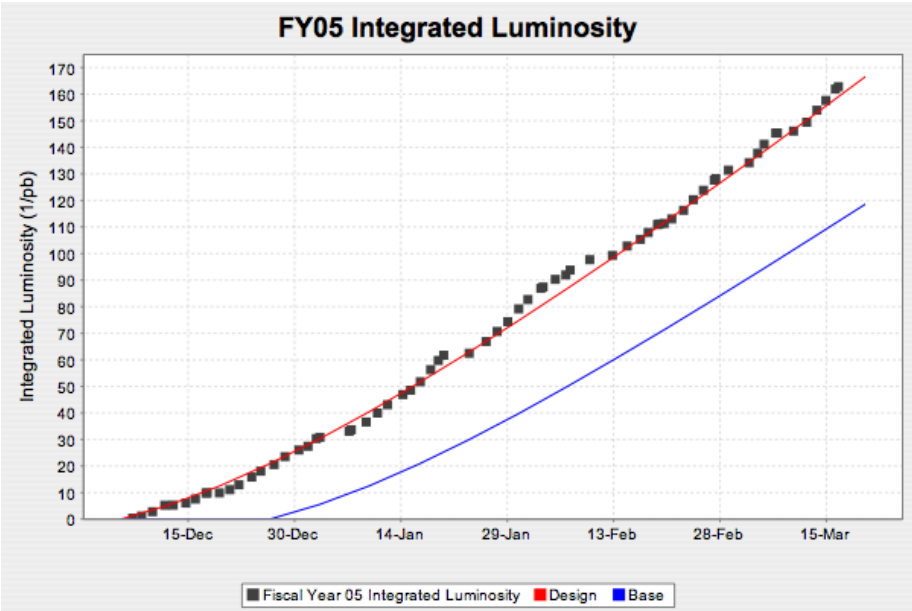


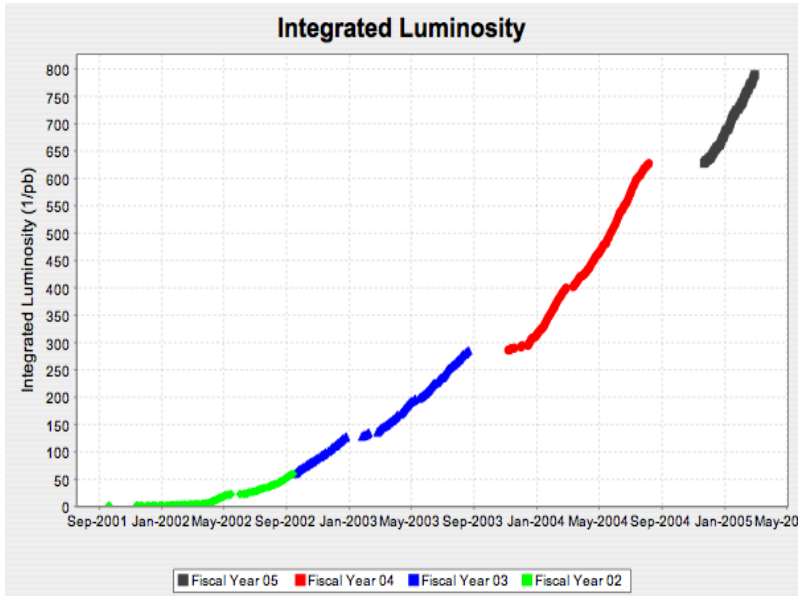
The Run II Campaign



- We are carrying out a campaign to optimize the science done throughout this period.
  - Organize entire laboratory to support the accelerator effort.
  - Build and install luminosity upgrade projects 2004-2006.
  - Deliver luminosity continuously 2004-2009.
  - Maintain efficient detector operation with modest upgrades.
- We are optimizing the science by delivering as much integrated luminosity as possible each year.

Tevatron Operations: FY 2004 Plan and Status





Integrated luminosity ~0.65 fb^{-1} on 10/04; plan ~1.1 fb^{-1} by 10/05

As of 3/21/04, we are on the FY 05 design curve with 0.18 pb^{-1}.

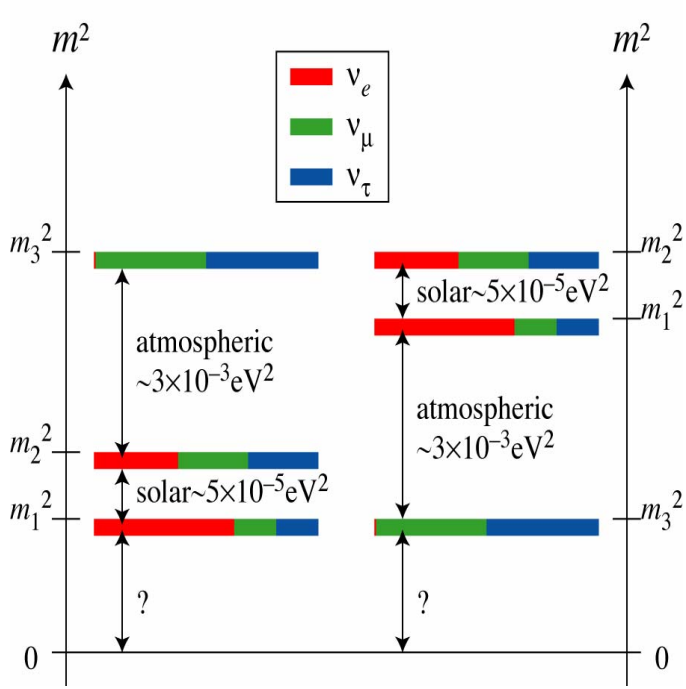
Record week 3/12-18: 19.8 pb^{-1}. Record luminosity 3/21: 1.17×10^{32}

The Neutrino Program

Is neutrino mass the first sign of physics at much higher energy?

- The greatest experimental surprise of the last decade: neutrinos change their type.
  - Neutrino oscillations may signal new physics at a much higher mass scale.
  - They may also show a way to explaining baryogenesis.

- Fermilab is home of the US accelerator-based neutrino program:
  - MiniBooNE
  - NuMI/MINOS



MINOS

For atmospheric oscillation

- Demonstrate oscillations
- Measure precisely the fundamental parameters of the oscillation
  - Δm^2 to ~10%
  - $\text{Sin}^2\, 2\theta_{23}$ to ~5%
- Improved sensitivity to transition of ν_μ to flavors other than ν_τ
  - improved sensitivity to θ_{13}

NuMI-MINOS status

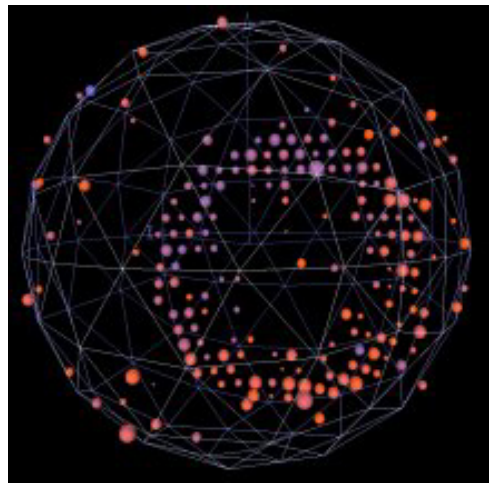
The NuMI construction project is complete.

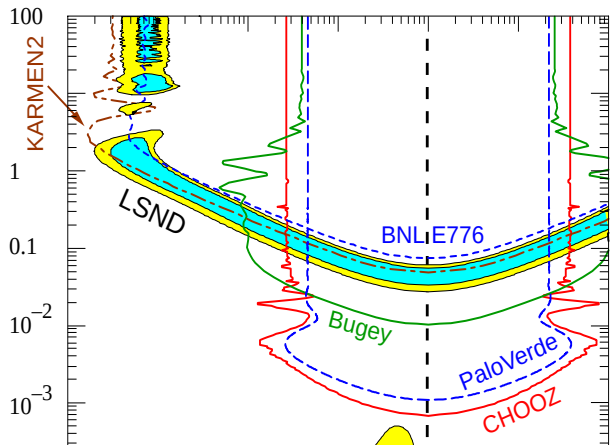
- MINOS is starting to operate for physics.
  - The initial goal is 2.5×10^{13} protons/pulse @ 0.5 Hz.
  - The near and far detectors are up and running.
- We are integrating the NuMI beam into routine operation of the accelerator complex.

1/21:The first event in the near detector
3/20: The first event in the far detector

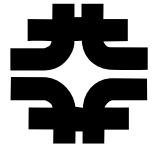
MiniBooNE

- MiniBooNE is designed to follow up on the LSND evidence of a $\nu_\mu - \nu_e$ oscillation at high Δm^2.
  - If MiniBooNE confirms LSND, it will change the worldwide neutrino program overnight.
- The beam and experiment are running well.
  - The integrated number of protons on target (POT) is 4.9×10^{20}.
  - Will pass 5×10^{20} in April.
  - Installed new horn during shutdown.



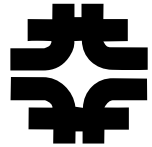


The last year at Fermilab



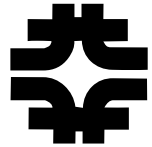
- Run II
  - Increased integrated luminosity from 0.4 to 0.8 fb^{-1}.
  - Increased record luminosity from 0.7 to 1.17 x 10^{32} cm^{-2} s^{-1}.
  - Integrated Recycler into routine operations.
  - Set new records for stacking rate using slip-stacking.
  - Installed the e-cooling apparatus into the Recycler.
  - Produced a lot of physics results
- Neutrinos
  - Completed NuMI project and celebrated.
  - Commissioned NuMI beamline.
  - Observed first neutrinos in MINOS near detector.
  - Increased MiniBooNE total POT from 2.1E20 to 4.9E20.
  - Installed Replacement MiniBooNE horn.

The last year



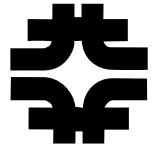
- External 120 GeV beams
  - Operated MIPP experiment measuring central production of hadrons.
  - Operated Main Injector test beam.
- Experimental astrophysics (not in this review)
  - Operated CDMS-II in Soudan, produced first results that are best in the world, installed more detectors.
  - Built toward full Auger while taking data with largest operating array.
  - Operated SDSS and made important discoveries.
  - Developed Dark Energy Survey.
  - Did some work on the Joint Dark Energy Mission.

The last year



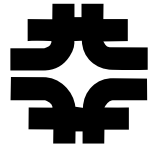
- We published the long-range plan in May, 2004 and took several immediate steps to implement it.
  - advanced ILC R&D and advanced ILC organization.
  - started SCRF test facility, SMTF.
  - did Proton Driver design study and technical review.
  - did Proton Driver physics study.
  - developed NOνA and smaller neutrino experiments
  - established LHC physics center (LPC).
  - launched LHC accelerator research program (LARP).
  - established Center for Particle Astrophysics.
  - are reacting to cancellation of BTeV in FY 2006 budget request

Executing the physics program



- Once the physics program is chosen, the operational goal is to execute it with good performance and high efficiency.
  - Organize the laboratory to support the program.
  - Improve the luminosity through 2006, then run efficiently.
  - Maximize protons delivered to the neutrino experiments.
  - Build up R&D on ILC and neutrino upgrades.
- This requires special attention to several areas.
  - Identify and mitigate risks to reliable operation.
  - Improve steadily the management of safety.
  - Manage the projects well.
  - Improve efficiency of operations where possible.
  - Move people and tasks across divisional boundaries to meet the needs.

Identifying and Mitigating Risk

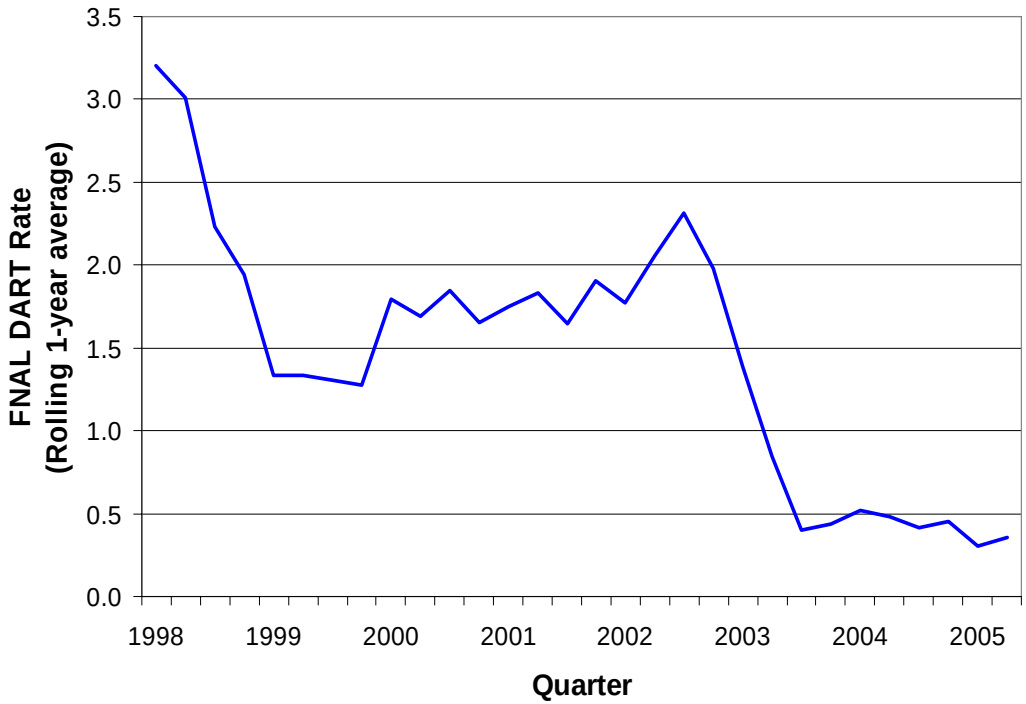


- Project managers, Division Heads, and Section Heads have primary responsibility for identifying and analyzing risks and developing a mitigation plan.
  - Risk that critical device will fail, shutting down program
  - Technological and schedule risks on projects and R&D
  - Risks to environment, safety, health, and security
  - Risk of noncompliance, for example, with DOE orders
  - Risk of damaging reputation of Fermilab or the DOE with neighboring communities or federal government
- Directorate has responsibility for setting priorities among these risks, evaluating mitigation plans, and providing resources those plans.
- We also have to consider the risk to the advance of particle physics if Fermilab does not have the strongest possible research program.

Safety

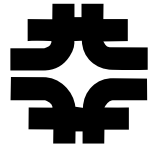
The laboratory management and staff have embraced Integrated Safety Management and have worked hard to bring the accident rates down.

- We have also made progress on integrating contractors into the safety culture we maintain.



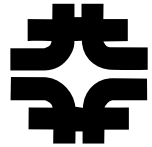
- We have reduced the DART (Days Away, Restricted, and Transferred) rate for FY 2003 to a record low of 0.4 per 100 worker-years.

Program Planning and The Physics Advisory Committee



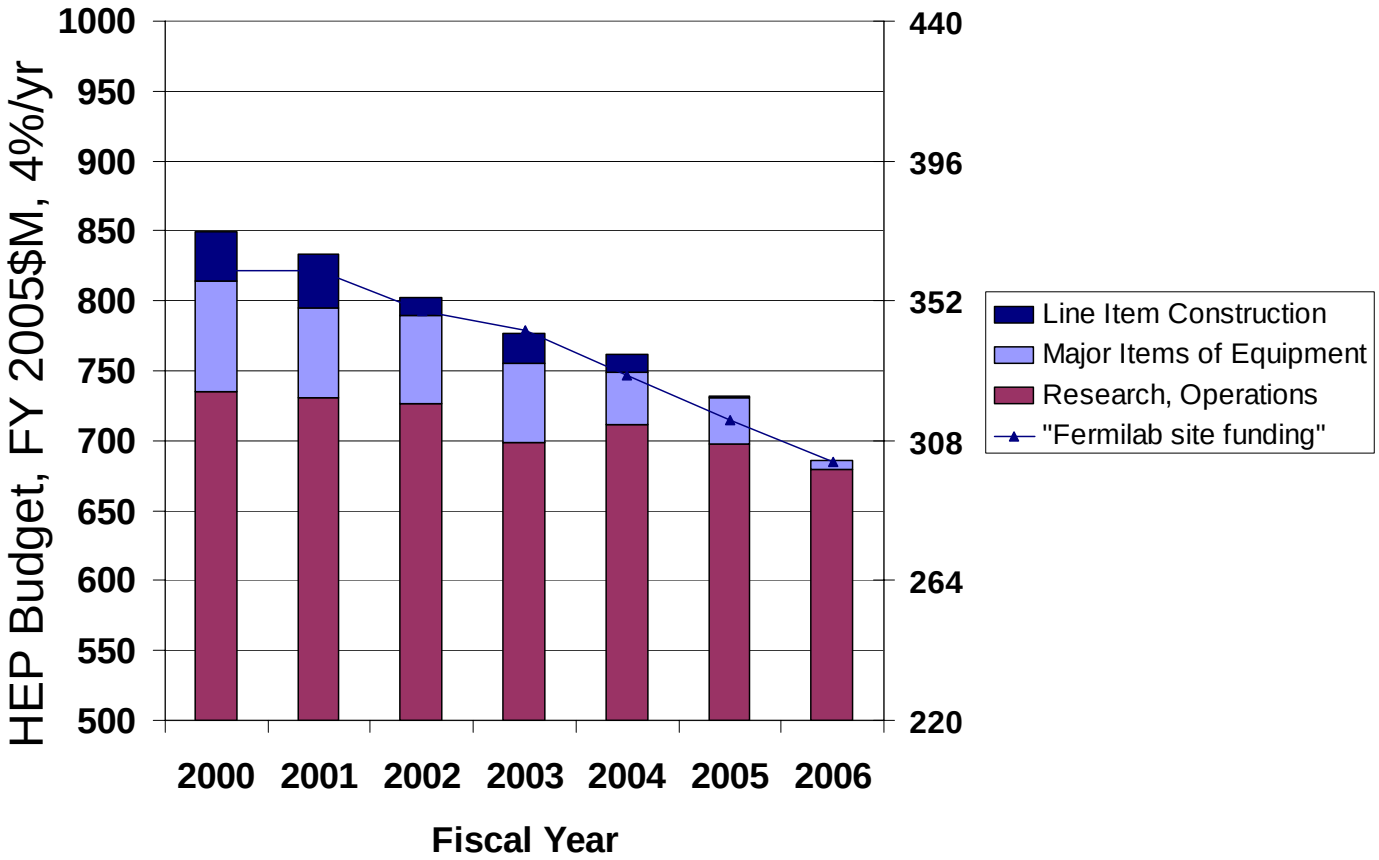
- We make good use of the Physics Advisory Committee in determining the scientific program of the laboratory.
- The Fermilab PAC does the most thorough review of experimental proposals of any similar committee in US HEP.
  - review by a technical committee
  - presentations and questions through several PAC meetings leading up to a presentation meeting in April followed by a weeklong retreat at Aspen
  - carefully written reports produced at the end of each meeting
  - extraordinary dedication of an excellent committee

Project management



- We have been working on three construction projects in the $100-200 M range.
  - NuMI is complete.
  - US-LHC is getting close to completion.
  - US-CMS is well along, but some critical subprojects are still ahead.
- All of these have been technically very difficult projects.
- We have done well at managing those projects over the last three years, and the Lehman reviews have been very positive.
  - The Project Management Oversight office is important in this success.
  - We have added rigorous director's reviews, to make sure that we recognize problems early and move to correct them.
  - You should refer to the material and reports from recent DOE project reviews.

HEP and Fermilab Budget 2000-2006, corrected at 4%/yr

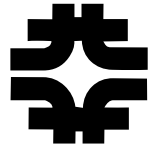


This describes the contraction in the field over this period.

FY 2005 Goals

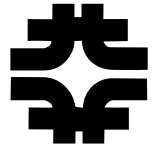
- Run II
  - Deliver 0.47 fb^{-1}; commission e-cooling.
  - Operate experiments; analyze data; produce results.
  - Upgrade infrastructure.
- Neutrinos
  - Complete >5E20 POT to MiniBooNE.
  - Establish NuMI operations at 2E13 ppp; start Proton Plan.
  - Move NOνA toward construction start and advance Proton Driver design.
  - Establish SMTF as primary base for SCRF R&D.
- LHC
  - Advance US-CMS project and the associated software and computing project and establish LPC role.
  - Deliver US-LHC commitments and establish LARP role.
- ILC
  - Build up Fermilab effort in ILC and organize design effort.
  - Establish SMTF as primary base for SCRF R&D.
- Particle Astrophysics
  - Advance construction and produce results for CDMS, Auger
  - Move DES toward being ready to start

FY 2005 Budget Strategy



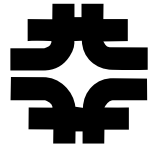
- Redirect resources from
  - NuMI project
  - LHC and CMS projects
  - BTeV R&D and preconstruction effort
  - Muon and NLC R&D (small amounts)
- Redirect resources to
  - ILC R&D
  - LARP and CMS research program
  - MINOS operations
  - Proton plan
  - NOνA and Proton Driver
  - SMTF
- Manage this with ~$10 M less in real effort.
  - Reduce staff by ~90 people + attrition.

Major DOE reviews



- Major annual reviews of the laboratory by the DOE
  - OHEP Budget meeting
  - This Operations Review
  - Business Plan Review by Office of Science
  - Annual Program Review
- The Operations and Program reviews are designed to cover distinct parts of the laboratory program.
  - Accelerators
    - Run II and fixed target operations
    - Run II upgrade program
    - Proton source improvements
  - Detectors
    - Operations of CDF, D0, and neutrino experiments
    - Computing for experiments
- The rest of the program will be covered in the Annual Program Review.

Summary



- Fermilab has a broad physics program matched to the most compelling issues in particle physics.
- Run II represents the most important physics program now operating in particle physics.
  - We continue to focus the laboratory on following the Run II plan.
- The Fermilab neutrino program is the only accelerator-based neutrino program now operating anywhere.
- As real budgets tighten each year, we need to manage the resources actively to meet commitments.